

SECTION 2

CONCRETE

2-01 SCOPE: The work covered by this section of the specifications consists in furnishing all plant, labor, equipment, appliances and materials not furnished by the Government, and in performing all operations in connection with the installation of concrete work, complete, in strict accordance with this section of the specifications and the applicable drawings, and subject to the terms and conditions of the contract.

2-02 APPLICABLE SPECIFICATIONS: The following specifications, standards and publications, of the issues listed below but referred to thereafter by basic designation only, form a part of this specification:

a. Federal Specifications:

P-O-361 Oil, Floors; Mineral.
HH-F-191a Felt; Asphalt-Saturated (for)
Flashings, Roofing, and Water-
proofing.
HH-F-341a Filler, Expansion-Joint, Preformed;
Nonextruding and Resilient-Types
(for Concrete).
QQ-B-71a Bars; Reinforcement (for) Concrete.
SS-A-231b Aggregate; (for) Portland-Cement-
Concrete.
SS-S-164 Sealer; Hot-Poured Type
SS-C-192a Cements; Portland
TT-C-593 Compound, Calking; Plastic (for
Masonry and Other Structures).
TT-W-572 Wood-Preservative; Water-Repellent.
UU-P-264a Paper; Concrete-Curing, Waterproofed
(Kraft).
WW-P-406 Pipe; Steel and Ferrous Alloy (for)
Ordinary Uses (Iron Pipe Size)
LLL-F-311 Fiber-Board; Hard-Pressed, Structural.
LLL-F-321b Fiberboard; Insulating.

b. Corps of Engineers Specifications:

CRD-C 300-52 Pigmented Membrane-Forming Com-
pounds for Curing Concrete.

c. American Society for Testing Materials Standards:

A 82-34 Cold-Drawn Steel Wire for Concrete
Reinforcement.
A 185-37 Welded Steel Wire Fabric for Concrete
Reinforcement.

- A 305-50 Minimum Requirements for the Deformations of Deformed Steel Bars for Concrete Reinforcement.
- C 31-49 Making and Curing Concrete Compression and Flexure Test Specimens in the Field.
- C 39-49 Compressive Strength of Molded Concrete Cylinders.
- C 40-48 Organic Impurities in Sands for Concrete.
- C 42-49 Securing, Preparing, and Testing Specimens from Hardened Concrete for Compressive and Flexural Strengths.
- C 192-52T Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory.

d. American Concrete Institute Publications:

- ACI 315-51 Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- ACE 318-51 Building Code Requirements for Reinforced Concrete.
- ACI 613-44 Recommended Practice for the Design of Concrete Mixes.

2-03 GENERAL: Full cooperation shall be given other trades to install embedded items. Suitable templates or instructions, or both, will be provided for setting items not placed in the forms. Embedded items shall have been inspected, and tests for concrete and other materials or for mechanical operations shall have been completed and approved, before concrete is placed.

2-04 MATERIALS:

a. Abrasives: Abrasive aggregate shall be aluminum oxide or emery graded from particles retained on a No. 52 sieve to particles passing a No. 8 sieve.

b. Aggregate: Both coarse and fine aggregate, except for gradation, limit of absorption, and sources of materials, shall conform to the requirements of Federal Specification SS-A-281. Limit of absorption shall not exceed 5%. The maximum size shall be one inch for Class AA and Class A concrete, and 1-1/2 inches for Class B concrete.

(1) General: Coarse and fine aggregate shall consist of crushed limestone and screenings, or other approved granular materials of similar characteristics, and shall be composed of hard, tough, durable and uncoated particles. The equipment and plant used in the production of coarse and fine

aggregate shall be designed for the aggregate conforming with the requirements of these specifications. Dust shall be removed by adequate washing. The particle shape of the smallest size of crushed coarse and fine aggregate shall be generally rounded or cubical, and the tolerance of flat and elongated particles in all sizes of the coarse and fine aggregate shall be governed by the inherent placeability requirements of the structure in which the mixture is to be placed. Rock which breaks down into thin, flat, elongated particles, regardless of the type of processing equipment used, will not be approved for use in the production of coarse and fine aggregate. A thin, flat and elongated particle is defined as a particle having a maximum dimension greater than five (5) times the minimum dimension. Aggregate shall not be manufactured from rock which is subject to weathering or disintegration when exposed to air or moisture nor from rock containing opaline or other active mineral.

(2) Coarse and fine aggregate: Coarse (types I & V) and fine (Types II & III) aggregate shall be well graded from fine to coarse and shall be within the grading limits shown in the following table:

TABLE OF GRADING LIMITS

Screen Sizes (Inches)	Percent by Weight Passing			
	Type I	Type II	Type III	Type V
2	100			
1-1/2	95-100			
1	20-55			100
3/4	0-15			95-100
1/2				
3/8	0-5	100		20-55
No.4		95-100		0-15
No.8		65-90	100	0-5
No.16		45-70	95-100	
No.30		25-45	40-70	
No.50		10-20	25-40	
No.100		2-8	0-25	
No.200	0-2	0-4	0-5	0-2

Type III aggregates are for Mortar, Plaster & Shotcrete.

c. Anchorage items: Slots and inserts for anchoring masonry and mechanical items to concrete shall be of standard manufacture, of types required to engage with the anchors to be provided and installed therein under other sections of these specifications, and shall be subject to approval.

(1) Slots shall be dovetail-type, formed of not lighter than 24-gage galvanized sheet steel, and shall be furnished with felt or fiber fillers.

(2) Inserts for shelf angles and bolt hangers shall be of iron and of sturdy design having adequate strength for the load to be carried. Inserts for shelf angles shall have an integral loop at the back, shall be slotted to receive a special headed bolt, shall have provision for nonslip vertical adjustment of shelf angle, and unless otherwise indicated, shall be furnished complete with special headed bolt not smaller than 5/8 inch in diameter of required length and fitted with hexagonal nut. Inserts for bolt hangers shall be either threaded or slotted as required by the type of hanger to be used; threaded inserts shall have integral lugs to prevent turning.

d. Asphalt-saturated felt: Federal Specification HH-F-191, 30-pound.

e. Cement: Only one brand of cement shall be used for exposed concrete in any individual structure. Cement reclaimed from cleaning bags or leaking containers shall not be used. Cement shall be used in the sequence of receipt of shipments, unless otherwise directed. Portland cement shall conform to Federal Specification SS-C-192, type I.

f. Curing materials:

(1) Waterproof paper: Federal Specification UU-P-264.

(2) Mats: Commercial quality of type used for the purpose.

(3) Burlap: Commercial quality.

(4) Membrane curing compounds: Corps of Engineers Specification CRD-C 300.

g. Drainage fill under concrete floor slabs and areaways shall be porous, free-draining material such as broken stone, gravel, or approved clean beach sand.

h. Expansion joints:

(1) Premolded expansion-joint filler strips: Federal Specification HH-F-341, sizes indicated on the drawings.

(2) Joint sealer, hot-poured type: Federal Specification SS-S-164, and shall be delivered to the building site in manufacturer's sealed containers.

(3) Joint compound, gun-type: Federal Specification TT-C-598, grade 1.

i. Forms shall be of wood, metal or other approved material and shall conform to the following requirements:

(1) Wood forms:

(a) Unexposed concrete surfaces: No.2 Common or better lumber.

(b) Exposed concrete surfaces: Dressed-and-matched boards of uniform thickness, and width not exceeding 10 inches.

(c) Rubbed or smooth surfaces: Plywood or with linings as specified below.

(2) Plywood: Commercial-Standard Douglas-Fir, moisture-resistant, concrete-form plywood, not less than 5-ply and at least 9/16 inch thick.

(3) Metal forms of approved type that will produce surfaces equal to those specified for wood forms.

(4) Hardboard forms: A hard-pressed fiberboard conforming to Federal Specification LLL-F-311, especially treated for concrete-form use, not less than 1/4 inch thick.

(5) Form lining:

(a) Plywood: Commercial-Standard Douglas-Fir, concrete-form exterior, 3-ply, not less than 1/4 inch thick.

(b) Fiberboard: A treated hard-pressed fiberboard, having a low degree of water absorptivity, not less than 3/16 inch thick, with one smooth side.

(6) Form oil: Federal Specification P-O-361, except that when used on hardboard forms the viscosity shall be not less than 250 seconds at 100° F.

(7) Form sealer: Federal Specification TT-W-572.

(8) Form ties shall be of approved design, fixed or adjustable in length, free of devices which will leave a hole larger than 7/8 inch in diameter in surface of concrete, and when used where discoloration of the concrete would be objectionable, metal remaining after removal of external parts shall be not less than one inch from the finished surface.

j. Reinforcement:

(1) Bars: Federal Specification QQ-B-71, type B, grade 2, except as otherwise noted on the drawings. Deformations shall conform to ASTM Standard A 305.

(2) Dowel bars shall be plain steel bars conforming to Federal Specification QQ-B-71. Dowel pipe shall

be steel pipe conforming to Federal Specification WW-P-406, extra strength.

(3) Mesh reinforcement: ASTM Standard A 185, except as specified otherwise hereinafter. When indicated in slabs on fill, mesh shall be of the sizes indicated, and gage shall be American steel wire gage.

(4) Mill reports: Certified copies of mill reports shall accompany deliveries of reinforcing steel, except mesh reinforcement.

k. Water shall be clean, fresh and free from injurious amounts of mineral and organic substances.

2-05 SAMPLES AND TESTING:

a. General: Testing of the aggregate, reinforcement, cement and end items shall be the responsibility of the Government. Samples of concrete for strength tests of end items shall be provided and stored by the Contractor when and as directed.

b. Cement shall be tested as prescribed in Federal Specification SS-C-192, and shall be sampled either at the mill or at the site of the work. Tests will be made by or under the supervision of the Contracting Officer, at the expense of the Government. No cement shall be used until notice has been given by the Contracting Officer that the test results are satisfactory. Cement which has been stored, other than in the bins at the mills, for more than 4 months after being tested shall be retested before use. Ordinarily, no cement shall be used until it has satisfactorily passed both the 7- and 28-day tests; but in cases of urgency the Contracting Officer may waive the 28-day tests and permit the use of cement which has satisfactorily passed the chemical, soundness, and 7-day tests, provided it is the product of a quarry and mill which have established a reputation of not less than 3 years' standing for the production of high-grade cement. Any cement delivered at the site of the work and later found under test to be unsuitable shall be removed from the work and its vicinity.

c. Aggregate shall be tested as prescribed in Federal Specification SS-A-281. In addition, fine aggregate shall be tested for organic impurities in conformance with ASTM Standard C 40.

d. Reinforcement: Reinforcing bars shall be tested as prescribed in Federal Specification QQ-B-71. Mesh reinforcement shall be tested as prescribed in ASTM Standard A 185.

e. Concrete:

(1) Strength tests during the work: The Contractor shall provide for test purposes one set of three

cylinders taken from each 250 cubic yards or fraction thereof, or each day's pour, whichever is less, of each class of concrete placed. Test specimens shall be made and cured in accordance with ASTM Standard C 31. Specimens shall be cured under laboratory conditions except that the Contracting Officer may require curing under field conditions. Cylinders shall be tested in accordance with ASTM Standard C 39. The test result shall be the average of the strengths of the three cylinders, except that if one specimen in a test shows manifest evidence of improper sampling, molding, or testing, the test result shall be the average of the remaining two specimens. If two specimens show such defects, the test shall be discarded. The standard age of test shall be 28 days, but 7-day tests may be used, with the permission of the Contracting Officer, provided that the relation between the 7-day and 28-day strengths of the concrete is established by tests for the materials and proportions used. If the average of the strength tests of the laboratory control specimens for any portion of the work falls below the minimum allowable compressive strength at 28 days required for the class of concrete used in that portion, the Contracting Officer shall have the right to order a change in the proportions or the water content of the concrete, or both, for the remaining portions of the work, at the Contractor's expense. If the average strength of the specimens cured on the job falls below the minimum allowable strength, the Contracting Officer may require changes in the conditions of temperature and moisture necessary to secure the required strength.

(2) Tests of hardened concrete in, or removed from, the structure: Where there is question as to the quality of the concrete in the structure, the Contracting Officer may require tests in accordance with ASTM Standard C 42 or order load tests for that portion of the structure where the questionable concrete has been placed. When required, the load tests shall be made, at the Contractor's expense, in accordance with section 202 of the ACI Building Code (ACI 318). In the event that load tests indicate that concrete placed does not conform to the drawings and these specifications, measures as prescribed by the Contracting Officer shall be taken to correct the deficiency at no additional expense to the Government.

2-06 STORAGE: Storage accommodations shall be subject to approval and shall afford easy access for inspection and identification of each shipment in accordance with test reports.

a. Cement: Immediately upon receipt at site of work, cement shall be stored in a dry, weathertight, properly ventilated structure, with adequate provision for prevention of absorption of moisture.

b. Aggregate: Storage piles of aggregate shall afford good drainage, preclude inclusion of foreign matter,

and preserve the gradation. Sufficient live storage shall be maintained to permit segregation of successive shipments, placement of concrete at required rate, and such procedures as heating, inspection, and testing.

2-07 FORMS, complete with centering, cores and molds, shall be constructed to conform to shape, form, line and grade required, and shall be maintained sufficiently rigid to prevent deformation under load. Where hardboard forms are used, studs shall be spaced sufficiently close to prevent deflection of hardboard and consequent waviness in surface of concrete.

a. Design: Joints shall be leakproof and shall be arranged vertically or horizontally to conform to the pattern of the design. Forms placed on successive units for continuous surfaces shall be fitted to accurate alignment to assure a smooth completed surface free from irregularities. In long spans, where intermediate supports are not possible, the anticipated deflection in the forms due to weight of fresh concrete shall be accurately figured and taken into account in the design of the forms, so that finished concrete members will have true surfaces conforming accurately to desired lines, plans and elevations. If adequate foundation for shores cannot be secured, trussed supports shall be provided. Temporary openings shall be arranged in wall and column forms and where otherwise required, to facilitate cleaning and inspection. Lumber once used in forms shall have nails withdrawn and surfaces to be exposed to concrete carefully cleaned before reuse. Forms shall be readily removable without hammering or prying against the concrete.

b. Form ties shall be of suitable design and adequate strength for the purpose. Wire ties will not be permitted where discoloration of the finished surface would be objectionable. Bolts and rods which are to be completely withdrawn shall be coated with grease.

c. Joints: Exterior corners of columns, girders, and beams and other exposed joints in more than one plane, unless otherwise indicated on the drawings or directed, shall be beveled, rounded, or chamfered by moldings placed in the forms.

d. Coating: Forms for exposed surfaces shall be coated with oil before reinforcement is placed. Surplus oil on form surfaces and any oil on reinforcing steel shall be removed. Forms for surfaces not exposed to view or normal weathering may be thoroughly wet with water in lieu of oiling immediately before placing of concrete, except that in cold weather with probable freezing temperatures, oiling shall be mandatory. Wood forms for concrete that is to be painted shall be coated with sealer instead of with oil or water.

e. Removal: Forms shall be removed only with approval of the Contracting Officer and in a manner to insure complete safety of the structure. Where the structure as a whole is supported on shores, the beam and girder sides, columns and similar vertical forms may be removed after 24 hours, provided concrete is sufficiently hard not to be injured thereby. In no case shall supporting forms or shoring be removed until members have the strength specified in subdivision "(1)" below. Care shall be taken to avoid spalling the concrete surface. Wood forms shall be completely removed from under porches, steps and similar spaces through temporary openings if necessary.

(1) Control tests: Results of suitable control tests will be used as evidence that concrete has attained sufficient strength to permit removal of supporting forms. Cylinders required for control tests shall be provided in addition to those otherwise required by this specification. Test specimens shall be removed from molds at end of 24 hours and stored in the structure as near points of sampling as possible, shall receive insofar as practicable the same protection from the elements during curing as is given those portions of the structure which they represent, and shall not be removed from the structure for transmittal to the laboratory prior to expiration of three-fourths of the proposed period before removal of forms. In general, supporting forms or shoring shall not be removed until strength of control-test specimens has attained a value of at least 1,500 pounds for columns and 2,000 pounds for all other work. Care must be exercised to assure that the newly unsupported portions of the structure are not subjected to heavy construction or material loading.

(2) Clamps: Tie-rod clamps to be entirely removed from the wall shall be loosened 24 hours after concrete is placed, and form ties, except for a sufficient number to hold forms in place, may be removed at that time. Ties wholly withdrawn from wall shall be pulled toward inside face.

(3) Filling tie-rod or bolt holes: Holes left by bolts or tie rods shall be filled solid with cement mortar. Holes passing entirely through walls shall be filled from inside face with a device that will force the mortar through to outside face, using a stop held at the outside wall surface to insure complete filling. Holes which do not pass entirely through walls shall be packed full. Excess mortar at face of filled holes shall be struck off flush.

2-08 REINFORCING STEEL, fabricated to shapes and dimensions shown, shall be placed where indicated on the drawings or required to carry out intent of drawings and specifications. Before being placed, reinforcement shall be thoroughly cleaned of rust, mill scale or coating, including ice, that would reduce or destroy the bond. Reinforcement reduced in section shall not be used. Following any substantial delay in the work,

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previously placed reinforcement left for future bonding shall be inspected and cleaned. Reinforcement shall not be bent or straightened in a manner injurious to the material. Bars with kinks or bends not shown on drawings shall not be placed. The heating of reinforcement for bending or straightening will be permitted only if the entire operation is approved by the Contracting Officer. In slabs, beams and girders, reinforcement shall not be spliced at points of maximum stress. Laps or splices shall be of adequate length to transmit stresses and, unless otherwise indicated, shall conform to the table in ACI 315. Splices in adjacent bars shall be staggered. Splices in columns, piers and struts shall be lapped sufficiently to transfer the full stress by bond.

a. Design: Unless otherwise indicated on the drawings, the details of reinforcing steel shall conform to the ACI Building Code (ACI 318). Except as otherwise shown on the drawings or specified, construction shall conform to the following requirements:

(1) Concrete covering over steel reinforcement shall be not less than the following thicknesses:

Footings and other principal structural members in which concrete is deposited against the ground 3 inches between steel and ground.

Where concrete surfaces, after removal of forms, are exposed to weather or ground:

For bars more than 5/8 inch in diameter 2 inches.

For bars 5/8 inch or less in diameter 1-1/2 inches.

Where surfaces are not directly exposed to weather or ground:

For slabs and walls 3/4 inch.

For beams, girders, and tied columns 1-1/2 inches.

ALL covering Equal to
diameter of
round bars and
1-1/2 times
side dimension
of square bars.

Exposed reinforcement bars intended for bonding with future extensions shall be protected from corrosion by concrete or other adequate covering.

(2) Steel in walls and lintel beams, unless otherwise shown, shall be continuous throughout the length of the various members. Splices shall not occur at critical sections.

(3) Stirrup spacer bars: All stirrups, except ties, shall be held in place by two 3/8-inch spacer bars extending full length of that portion of the beam or girder occupied by stirrups.

(4) Outside bars of slab reinforcement, both main and temperature, parallel to beams, girders or walls, shall be placed not over one-half bar spacing from the adjacent face of each member.

(5) Wire-mesh reinforcement, when used in slabs, shall be supported at proper elevations by standard accessories. In slabs on ground, precast concrete blocks may be substituted for chairs.

(6) Shop drawings: Shop detail and placing drawings for all reinforcing steel shall be furnished for approval.

b. Supports: With the exception of temperature reinforcement which shall be tied to main steel approximately 24 inches on centers, reinforcement shall be accurately placed and securely tied at all intersections and splices with 13-gage black annealed wire, and shall be securely held in position during the placing of concrete by spacers, chairs or other approved supports. Wire-tie ends shall point away from the form. Unless otherwise indicated on the drawings or specified, the number, type and spacing of supports shall conform to the ACI Detailing Manual (ACI 315).

(1) For slabs on grade (over earth or over drainage fill) and for footing reinforcement: Bars or mesh shall be supported on precast concrete blocks, spaced at

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intervals required by size of reinforcement used, to keep reinforcement the minimum height specified above the underside of slab or footing.

2-09 CLASSES OF CONCRETE AND USAGE:

a. Strength requirements: Concrete of the various classes required shall be proportioned and mixed for the following strengths:

Class of Concrete	Minimum allowable compressive Strength at 28 days Pounds per square inch
AA	3,000
A	2,500
B	2,000

b. Usage: Concrete of the various classes shall be used as follows:

(1) Class AA concrete: For precast work and for such other reinforced work as noted on the drawings or specified.

(2) Class A concrete: For all reinforced work not otherwise shown on the drawings or specified.

(3) Class B concrete: For all concrete not reinforced except as otherwise shown on the drawings or specified.

2-10 PROPORTIONING OF CONCRETE MIXES: Concrete shall be proportioned by weight.

a. Measurements:

(1) Cement: A one-cubic-foot bag of portland cement will be considered as 94 pounds in weight. In determining the approved mix, portland cement will be used alone as the cementitious material.

(2) Water: One gallon of water will be considered as 8.33 pounds.

(3) Aggregate: Coarse aggregate shall be used in the greatest amount consistent with required workability and shall be of the largest size suitable for the work and economically available. Grade A aggregate as described in Federal Specification SS-A-281 shall be used for concrete for exterior exposure and foundation walls in contact with earth; grade B aggregate may be used in other concrete unless otherwise noted on the drawings or directed.

b. Corrective additions to remedy deficiencies in aggregate gradations shall be used only with the written approval of the Contracting Officer. When such additions are permitted, the material shall be measured separately for each batch of concrete.

c. Control: The design of the concrete mixture, to meet strength requirements of the class or classes of concrete specified, shall be the responsibility of the Contracting Officer. In designing the mix, aggregate proposed for use by the Contractor and approved by the Contracting Officer will be used. The design mix will be determined well in advance of commencement of the work so as to cause no delay.

(1) Mix Design: Before placing any concrete, adequate quantities of the concrete ingredients proposed for use shall be supplied to the Contracting Officer for making trial design mixes. In case of change in source or character of concrete ingredients after concrete placing has started, sufficient quantities of ingredients, including the new material, shall be furnished the Contracting Officer for determining a new mix. No substitutions shall be made in the materials used in the work without the approval of the Contracting Officer. Average cement content and maximum water per bag of cement will be as follows:

Class of Concrete	Average Cement Content	Maximum Water Per
	Bags of Cement per Cubic Yard	Bag of Cement Gallon
AA	5.5	6.0
A	5.0	6.75
B	4.5	7.5

(2) Slump test: Consistency will be determined by the slump test. The slump shall be 2 inches minimum and 3 inches maximum for vibrated concrete. When placing of concrete without vibration is approved, slump shall be from 3 to 6 inches.

(3) Mix proportions: Preliminary mix proportions will be furnished the Contractor by the Contracting Officer before start of operations. Adjustments will be made by the Contracting Officer, as required, to determine final proportions which will best satisfy job requirements and use of materials. Subsequent adjustment in these final mix proportions shall be made by the Contracting Officer as required to compensate for variations in the gradation and moisture content of the aggregates. Necessary revisions in water-cement ratio and concrete mix proportions shall be made as directed.

(4) Workability: The consistency of the mixture will be that required for the specific conditions and

method of placement. The slump shall not exceed that specified above.

(5) Strength Tests: The Contracting Officer will determine the strength of the concrete in the completed work during the progress of construction by test specimens made, cured and tested as specified herein under SAMPLES AND TESTING. Modifications of the design mix, if required, will be made by the Contracting Officer on the basis of the strength of these test specimens. There will be no additional compensation for changing the proportions of the mix to overcome field and aggregate deficiencies or to obtain the specified qualities and characteristics of the concrete.

2-11 JOB-MIXED CONCRETE BATCHING AND MIXING: Concrete shall be mixed by a mechanical batch-type mixing plant provided with adequate facilities for accurate measurement and control of each material entering the mixer and for changing the proportions to conform to varying conditions of the work. The mixing-plant assembly shall permit ready inspection of operations at all times. The plant and its location shall be subject to approval.

a. Batching units shall be supplied with the following items:

(1) Weighing unit shall be provided for each type of material to indicate the scale load at convenient stages of the weighing operation. Weighing units shall be checked at times directed by and in the presence of the Contracting Officer, and required adjustments shall be made before further use.

(2) Water mechanism shall be tight, with the valves interlocked so that the discharge valves cannot be opened before the filling valve is fully closed, and shall be fitted with a graduated gage.

(3) Discharge gate shall control the mix to produce a ribboning and mixing of cement with aggregate. Delivery of materials from the batching equipment to the mixer shall be accurate within the following limits:

<u>Material</u>		<u>Material</u>	
Percentage by weight		Percentage by weight	
Cement	1/2	Fine aggregate	1
Water	1/2	Coarse aggregate ..	2

b. Mixing unit:

(1) Operation: Mixers shall not be charged in excess of rated capacity nor operated in excess of rated speed.

Excessive mixing, requiring addition of water to preserve required consistency, will not be permitted. The entire batch shall be discharged before recharging.

(2) Mixing time shall be measured from the instant water is introduced into the drum containing all solids. All mixing water shall be introduced before one-fourth of the mixing time has elapsed. Mixing time for mixers of 1 cubic yard or less shall be 1-1/4 minutes; for mixers larger than 1 cubic yard, mixing time shall be increased 15 seconds for each additional half cubic yard or fraction thereof. If an air-entraining agent is used, additional mixing time shall be such as to provide the specified air content.

(3) Discharge lock: Unless waived by the Contracting Officer, a device to lock the discharge mechanism until the required mixing time has elapsed shall be provided on each mixer.

2-12 EXPANSION JOINTS shall be constructed as indicated on the drawings and as approved. In no case shall the reinforcement, corner protection angles or other fixed metal items embedded in or bonded into concrete be run continuous through an expansion joint.

a. Joints between slabs on earth and vertical surfaces where indicated shall be of premolded expansion-joint filler strips. Unless otherwise noted or specified, such joints shall be 1/2 inch thick and the full depth of slab.

b. Joints with compound: Where joints are indicated to receive joint compound, the premolded expansion-joint filler strips, or other approved premolded strip material, shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled, wood strip temporarily secured to the top thereof. The wood strip shall be of sufficient depth to form a groove not less than 1 inch deep. After the concrete has set, the wood strip shall be removed and the groove shall be filled with a light-colored calking compound or with compound for poured application. Joint grooves shall be filled approximately flush, so as to be slightly concave after drying.

c. Finish at joint: Edges of cement floors or concrete slabs along expansion joints shall be neatly finished with a slightly rounded edging tool.

2-13 CONSTRUCTION JOINTS: The unit of operation shall not exceed 80 feet in any horizontal direction, unless otherwise required by the drawings. Concrete shall be placed continuously so that the unit will be monolithic in construction. At least 48 hours shall elapse between the casting of adjoining units, unless this requirement is waived by the Contracting

Officer. Construction joints, if required, shall be located near the midpoint of spans for slabs, beams or girders, unless a beam intersects a girder at the center, in which case the joints in the girder shall be offset a distance equal to twice the width of the beam and provision for shear shall be made by use of inclined reinforcement. Joints in columns or piers shall be made at the underside of the deepest beam or girder framed thereto. Columns, piers or walls of ordinary height shall be poured at least 2 hours before any overhead work is placed thereon. Joints not shown or specified shall be so located as to least impair strength and appearance of work. Vertical joints in wall footings shall be reduced to a minimum. Except where indicated on the drawings, no jointing shall be made in footings or foundation work without written approval. Placement of concrete shall be at such a rate that surfaces of concrete not carried to joint levels will not have attained initial set before additional concrete is placed thereon. Girders, beams and slabs shall be placed in one operation. In walls of buildings having door and window openings, lifts of individual pours shall terminate at top and bottom of opening. Other lifts shall terminate at such levels as are indicated on the drawings, or to conform to structural requirements or architectural details, or both, as directed. Special provision shall be made for jointing successive pours as detailed on the drawings or required. To insure a level, straight joint in exposed vertical surfaces, a strip of dressed lumber may be tacked to the inside of the forms at the construction joint. The concrete shall be poured to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, any irregularities in the joint line leveled off with a wood float, and all laitance removed.

2-14 INSTALLATION OF ANCHORAGE ITEMS:

- a. Slots: Adequate slots or inserts shall be provided for anchoring members at openings. Slots shall be provided for anchoring ends of masonry partitions abutting concrete.
- b. Inserts for hangers for piping and mechanical fixtures shall be furnished under PLUMBING. These items shall be installed under this section of the specifications as required under PLUMBING.

2-15 PREPARATION FOR PLACING: Water shall be removed from excavations before concrete is deposited. Any flow of water shall be diverted through proper side drains and shall be removed without washing over freshly deposited concrete. Hardened concrete, debris and foreign materials shall be removed from interior of forms and from inner surfaces of mixing and conveying equipment. Reinforcement shall be secured in position, inspected and approved before pouring of concrete. Runways shall be provided for wheeled concrete-handling equipment; such equipment shall not be wheeled over reinforcement

nor shall runways be supported on reinforcement. The subgrade shall be finished to the exact section of the bottom of the floor slab and shall be maintained in a smooth, compacted condition, in conformity with the required section and grade until the concrete is in place. The subgrade shall be thoroughly moistened, but not muddy, at the time the concrete is deposited, except as specified by paragraph 2-19 below.

2-16 PLACING CONCRETE: No concrete shall be placed in final position except in the presence of a Government inspector. The use of belt conveyors, chutes or similar equipment will not be permitted without written approval. Concrete shall be handled from mixer or transport vehicle to place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients until the approved unit of operation is completed. Concrete that has attained its initial set or has contained its mixing water for more than 45 minutes shall not be placed in the work. Placing will not be permitted when, in the opinion of the Contracting Officer, the sun, heat, wind or limitations of facilities furnished by the Contractor prevent proper finishing and curing of the concrete. Forms or reinforcement shall not be splashed with concrete in advance of pouring. Concrete shall be placed in the forms as nearly as practicable in final position. Immediately after placing, concrete shall be compacted by thoroughly agitating in an approved manner. Tapping or other external vibration of forms will not be permitted. Concrete shall not be placed on concrete sufficiently hard to cause formation of seams and planes of weakness within the section. Concrete shall not be allowed to drop freely more than 5 feet in unexposed work nor more than 3 feet in exposed work; where greater drops are required, a tremie or other approved means shall be employed. The discharge of the tremies shall be controlled so that the concrete may be effectively compacted into horizontal layers not more than 12 inches thick, and the spacing of the tremies shall be such that segregation does not occur.

a. Earth-foundation placement: Concrete footings shall be placed upon undisturbed clean surfaces, free from mud and water. When the foundation is on dry soil or pervious material, waterproof sheathing paper shall be laid over earth surfaces to receive concrete.

b. Rock-foundation placement: Rock surfaces upon which concrete is to be placed shall be approximately level, clean, free from oil and other objectionable coatings, water, mud, debris, drummy rock and loose semidetached or unsound fragments, and shall be sufficiently rough to assure satisfactory bond with the concrete. Faults or seams shall be cleaned to firm rock on the sides, and to a depth satisfactory to the Contracting Officer. Immediately before concrete is placed, rock surfaces shall be cleaned by high-velocity air-water jets, sand blasting or other means satisfactory to the Contracting Officer.

c. Chute placement: When, upon written approval, concrete is conveyed by chute, there shall be a continuous flow of concrete. The chute shall be of metal or metal-lined wood, with sections set at approximately the same slope; namely, not less than 1 vertical to 3 horizontal nor more than 1 vertical to 2 horizontal. The discharge end of the chute shall be provided with a baffle plate to prevent segregation. If the height of the discharge end of chute is more than 3 times the thickness of layer being deposited, but not more than 5 feet above surface of concrete in forms, a spout shall be used, and the lower end maintained as near surface of deposit as practicable. When pouring is intermittent, the chute shall discharge into a hopper. The chute shall be thoroughly cleaned before and after each run. Waste material and flushing water shall be discharged outside the forms.

2-17 COMPACTION: Concrete shall be placed in layers not over 12 inches deep. Each layer shall be compacted by mechanical internal-vibrating equipment supplemented by hand-spading, rodding and tamping as directed. Vibrators shall in no case be used to transport concrete inside forms. Use of form vibrators will not be permitted. Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the concrete. At least one spare vibrator or sufficient parts for repairing vibrators shall be maintained at the site at all times. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing objectionable segregation and shall be at least 20 seconds per square foot of exposed surface. The vibrator shall not be inserted into lower courses that have begun to set. Where absorptive form lining is used, the vibrator shall not be placed between the forms and the outer row of reinforcement, and in no case shall the vibrator be allowed to touch the absorptive form lining. Vibrators shall be applied at uniformly spaced points not farther apart than the visible effectiveness of the machine.

2-18 BONDING AND GROUTING: Before depositing new concrete on or against concrete that has set, existing surfaces shall be thoroughly roughened and cleaned of laitance, foreign matter and loose particles. Forms shall be retightened and existing surfaces slushed with a grout coat of neat cement. New concrete shall be placed before the grout has attained initial set. Horizontal construction joints shall be given a brush coat of grout consisting of cement and fine aggregate in the same proportion as concrete to be placed, followed by approximately 3 inches of concrete of regular mix except that the proportion of coarse aggregate shall be reduced 50 percent. Grout for setting column bases, wall plates and other metal items shall be composed of equal parts of sand and portland cement, with water sufficient to produce required consistency.

2-19 SLABS ON GRADE: The installation of underground and embedded items shall be approved before slabs are placed. Any fill indicated or required to raise the subgrade shall be

installed as specified in the section on EXCAVATION, FILLING, AND BACKFILLING FOR BUILDING CONSTRUCTION. Sand or gravel drainage fill, 6 inches thick, shall be installed under interior floor slabs, shall be leveled to a reasonably true and even surface, and shall be covered with kraft paper of the kind used for curing, or with 30-pound asphalt-saturated felt, lapped at least 4 inches at edges and ends. The concrete shall have a slump of no more than 2 inches unless specifically authorized. Concrete shall be compacted, screeded to grade, and prepared for the specified finish. Contraction joints shall be provided in large slabs by pouring the slab in alternate checkerboard sections approximately 800 square feet in area or, at the option of the Contractor, the slab may be poured continuous, as limited by expansion and construction joints, and contraction joints may be cut with an approved concrete-sawing machine or may be formed by the insertion of fiberboard strips in the wet concrete. Sawed joints shall be cut at a time to be determined by the Contracting Officer and shall be 1/8 inch in width and approximately 1/4 of the slab thickness in depth, unless otherwise shown on the drawings or directed; sludge and cutting debris shall be removed from cut joints. Fiberboard joints shall be made with a strip of 1/8-inch-thick hard-pressed fiberboard approximately 1/4 of the slab thickness in width and in as long lengths as practicable. After the first floating, the concrete shall be grooved with a tool, to a depth approximately equal to the width of the strip, at the desired joint locations. The strip shall be inserted in the groove until the top edge is flush with the surface of slab, using a U-shaped device of sheet metal fitted over the top edge of the strip to maintain alignment. When the concrete has set sufficiently to retain the strip, the sheet metal device shall be withdrawn. The slab shall be floated and finished as specified, using an edging tool on each side of the inserted joint.

2-20 FINISHED OF CONCRETE OTHER THAN FLOORS AND SLABS: Slight honeycomb and minor defects shall be patched with cement mortar of 1 part cement to 2 parts fine aggregate. Exposed surfaces shall be given one of the following finished, as indicated on the drawings or specified:

a. Rough finish: Concrete for which no other finish is indicated or specified shall have fins and rough edges removed.

b. Smooth finish shall be given to all exposed exterior and interior concrete surfaces which are not to be covered by other construction and shall be obtained by use of hardboard or plywood forms, form linings, or forms specially designed for reuse. Forms and form linings shall be used in as large sheets as practicable, with smooth even edges, and forms and form linings shall be installed with close joints. Joint marks shall be smoothed off and blemishes removed, leaving finished surfaces smooth and unmarred, subject to approval,

except that joint marks resulting from the use of forms specially designed for reuse which produce a pattern regular and pleasing in appearance and which do not impair the integrity of the surface need not be removed.

c. Rubbed finish shall be given to surfaces indicated on the drawings. Fins and other projections shall be carefully removed, offsets leveled and damaged places repaired. Surfaces shall then be rubbed with cement or carborundum bricks and water. No mortar or grout shall be employed in the rubbing. Form marks and similar blemishes shall be removed, leaving the surface finish uniformly smooth and washed clean.

d. Surfaces to receive plaster or shotcrete:

(1) Surface treatment: Surfaces to which plaster or shotcrete are to be applied directly shall be removed to a depth of not less than 1/16 inch by chipping with a pneumatic chisel, by retarding the setting of the surface cement with a compound and removing the surface by scouring, or by other approved method which will expose the aggregate and leave a clean, firm, rough, granular surface. Treatment shall not affect the setting or strength of the cement beyond a depth of 1/8 inch nor prevent the setting of the surface cement within a reasonable time after the forms are removed. Soffits of concrete joists less than 6 inches wide between masonry unit fillers need no special treatment.

(2) Flexible inserts: In lieu of the chipping or scouring treatment as specified for surfaces to receive plaster or shotcrete, when wood forms are used, flexible dovetail inserts to form cavities for mechanical bonding of the surfacing materials may be used at the option of the Contractor. The inserts shall be approximately 3/8 inch deep by 2 inches in diameter, attached to the forms 12 inches on centers in accordance with the manufacturer's directions, and shall be easily removable without damaging the concrete.

e. Sample concrete panels: The contractor shall pour for approval a sufficient number of sample concrete panels to show the surface finished required. Each panel shall be not less than 6 feet long by 4 feet high. Pouring of concrete requiring the finish indicated by the samples shall not proceed until the sample panel has been approved.

2-21 CONCRETE FLOOR AND ROOF-SLAB FINISHES: Concrete slabs shall be finished as hereinafter described. The dusting of wearing surfaces with dry materials will not be permitted. In preparation for finishing, floor slabs shall be struck off true to the required level at or below the elevation or grade of the finished floors, as shown on the drawings. Floors shall be level with a tolerance of 1/8 inch in 10 feet except where drains occur, in which case the floors shall be pitched to the drains as indicated on the drawings or as directed.

a. Monolithic finish: Floors where no floor covering is specified shall be finished by tamping the concrete with special tools to force the coarse aggregate away from the surface, then screeding and floating with straightedges to bring the surface to the required finish level shown on the drawings. While the concrete is still green but sufficiently hardened to bear a man's weight without deep imprint, it shall be wood-floated to a true even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood floats to bring moisture to the surface. The concrete shall then be hand-troweled to produce a smooth impervious surface free from trowel marks. An additional troweling shall be given the surface for the purpose of burnishing. The final troweling shall produce a ringing sound from the trowel.

b. Rough slab finish: Floors to receive ceramic tile shall be finished by tamping the concrete with special tools to force the aggregate away from the surface, then screeding with straightedges and floating to produce a reasonably true and uniform surface. Floor slabs to receive fill, deferred topping, or other floor finishes and not requiring membrane waterproofing shall be screeded and broomed. In addition to screeding and floating, slabs to receive membrane waterproofing or roofing shall be lightly steel-troweled.

c. Smooth integral cement finish: Floors, where required or directed, shall have a smooth integral cement finish applied as follows: The finish coat shall be not less than 1/2 inch thick, applied after screeding while the concrete is still green, but after all surface water has disappeared (not more than 30 to 45 minutes). The mix shall be 1 part portland cement, 1 part fine aggregate and 2 parts coarse aggregate. The fine aggregate shall pass a 1/4-inch-mesh sieve, with not more than 5 percent passing 100-mesh sieve, and not more than 10 percent passing a 50-mesh sieve. The coarse aggregate shall be graded from 1/8 inch to 3/8 inch, with at least 95 percent passing a 3/8-inch sieve and not over 10% passing a No. 8 sieve. The water shall not exceed 5 gallons per sack of cement. The finish shall be screeded to a true and even surface, then floated and troweled smooth. No floating or troweling of the surface shall be done while the finish coat is wet or sloppy. After having set sufficiently to ring the trowel, the work shall be given a second troweling and burnishing.

d. Wood-float finish: Sidewalks and ramps shall be finished by tamping with special tools to force aggregate away from the surface, then screeding with straightedges to bring surface to required line as shown on the drawings. While the concrete is still green but hardened sufficiently to bear the cement finisher's weight, the surface shall be wood-floated to a true and uniform plane with no coarse aggregate visible.

Non-slip finish: Stair treads and platforms having cement finish shall have a nonslip finish produced by evenly sprinkling not less than $\frac{1}{4}$ pound of abrasive material over each square foot of the finish cement, which has been screeded level, and finishing with a wood float.

f. Finish to receive asphalt-tile shall be produced by one of the following methods at the contractor's option:

(1) Roller-and-screed method: The slab shall be finished by tamping with special tools to force the aggregate away from the surface and then brought to the required height by a roller not less than 6 inches in diameter and of an approved type. The roller shall be carried on screeds accurately set in the work and sufficiently rigid to withstand the rolling. Concrete shall be maintained ahead of the roller at a height to insure complete compaction of the surface. Areas not reached by rolling shall be thoroughly tamped. After surface water has disappeared and the concrete is sufficiently firm to hold a man's weight, the floor shall be troweled to a true, even, smooth surface.

(2) Smooth-integral-cement-finish method: The slab shall be finished as specified hereinbefore for smooth integral cement finish, except that the finish coat may be composed of a 1:1 $\frac{1}{2}$:3 mix of the cement, fine aggregate, and coarse aggregate, and the surface left after the first troweling omitting the second troweling and burnishing.

g. Power-machine finishing: In lieu of hand finishing, the Contractor may use an approved power machine for finishing concrete floors in accordance with the directions of the machine manufacturer. The preparation of concrete surfaces for finishing by machine shall in general be as hereinbefore required for hand finishing.

2-22 CURING shall be accomplished by preventing loss of moisture, rapid temperature change, and mechanical injury or injury from rain or flowing water for a period of 7 days when normal portland cement has been used or 3 days when high-early-strength portland cement has been used. Curing shall be started as soon after placing and finishing as free water has disappeared from the surface of the concrete. Curing may be accomplished by any of the following methods or combination thereof, as approved.

a. Moist curing: Unformed surfaces shall be covered with burlap, cotton, or other approved fabric mats, or with sand and shall be kept continually wet. Forms shall be kept continually wet and if removed before the end of the curing period, curing shall be continued as on unformed surfaces, using suitable materials. Burlap shall be used only on surfaces which will be unexposed in the finished work and shall be in two layers.

b. Waterproof-paper curing: Surfaces shall be covered with waterproof paper lapped 4 inches at edges and ends and sealed. Paper shall be weighted to prevent displacement, and tears or holes appearing during the curing period shall be immediately repaired by patching.

c. Membrane curing: Membrane curing compound shall be applied by power spraying equipment using a spray nozzle equipped with a wind guard. The compound shall be applied in a two-coat, continuous operation at a coverage of not more than 200 square feet per gallon for both coats. When application is made by hand sprayers, the second coat shall be applied in a direction approximately at right angles to the direction of the first coat. The compound shall form a uniform, continuous, adherent film that shall not check, crack, or peel, and shall be free from pinholes or other imperfections. Surfaces subjected to heavy rainfall within 3 hours after compound has been applied or surfaces damaged by subsequent construction operations within the curing period shall be resprayed at the rate specified above. Membrane curing compound shall not be used on surfaces which are to receive concrete fill or setting beds, nor on surfaces which are to be treated with hardener. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic and other sources of abrasion during the curing period.

2-23 SHOTCRETE shall be applied where shown on the drawings to exterior concrete, concrete block and other surfaces to not less than 1/2 inch thick. The term "shotcrete" used herein and on the drawings is used descriptively to designate a mixture of portland cement and fine aggregate mixed dry, passed through a cement gun and conveyed by air through a flexible tube and deposited by air pressure in its place of final repose.

a. Mix: Unless otherwise specified, all shotcrete for base coats shall be mixed in the proportion of 1 part cement to 4 1/2 parts of sand by volume. Finish coat shall be a 1 to 3 mix. The proportions of mix shall be changed as required by the Contracting Officer to meet job conditions.

b. Fine Aggregate shall be as hereinbefore specified in paragraph 2-04.

c. Water used for hydration at the nozzle shall be maintained at a uniform pressure, which shall be at least 15 pounds per square inch above air pressure at the gun.

d. Operating requirements: For lengths of hose up to 100 feet, pneumatic pressure at gun shall be 30 pounds per square inch or more. Where length exceeds 100 feet, pressure shall be increased 5 pounds per square inch for each additional 50 feet of hose required. Steady pressure must be maintained.

e. Application: Surfaces to receive shotcrete shall be prepared as hereinbefore specified and shall be damped evenly, but not soaked, with a fog spray before the application of shotcrete. Shotcrete shall not be applied to a surface upon which free water exists. Material which rebounds and does not fall clear of the work, or which collects on horizontal surfaces, shall be blown off or removed. When air blowout jet is used to remove rebounds, care must be taken to avoid interference with the flow of shotcrete or the nozzleman. Rebounds recovered clean and free of foreign matter may be re-used as sand in quantity not to exceed 20% of the total sand requirements. All corners and angles, horizontal and vertical, shall be sharp and clean. Wires provided with turn-buckles shall be provided, anchored at end and drawn tight to act as screeds and grounds to formulate straight, sharp corners and even walls.

Temporary wood grounds are specified and included in the section on CARPENTRY. Shotcrete shall be applied to previously approved surfaces in two or more coats allowing proper curing between coats and preparing the previous coats by washing and cleaning with water and air blast. This surface shall then be rodded, cured and prepared, and the final coat shot in place. Base coats shall be applied with the nozzle being held 3 to 4 feet from and perpendicular to the surface, and moved in a narrow range. The finish coat shall be applied from a distance of 5 or 6 feet and in a slightly wider range. The finish coat shall be rubbed with burlap to create an even textured surface as approved by the Contracting Officer.

f. Construction joints: Particular care shall be given to formation of construction joints. They shall be sloped to a thin edge and the edge shall be thoroughly wetted before adjacent section of shotcrete is placed. No square joints will be allowed.

g. Curing: Shotcrete shall be damp-cured for at least five days after placing.

2-24 SETTING BEDS required over slabs for floor finishes other than concrete and cement floor finishes are covered under other sections of these specifications in which the floor finish is specified, and do not form a part of the work under this section.

2-25 PRECAST ITEMS: Items of concrete that are not shown as cast integral with and forming a part of the reinforced concrete structure shall be precast or cast-in-place, as noted on the drawings, to the designs shown, of class AA concrete using a 5/8-inch maximum size coarse aggregate. Pre-cast items shall be furnished under this section and set under the section on MASONRY; CONCRETE BLOCK. When cast in sections, the allowance for joints between sections shall be 1/4 inch and the ends shall be roughened for bond. Reinforcing steel shall be provided as shown and as required to prevent breakage. Precast trim items shall have an absorption of not more than 6 percent by weight after immersion in water for 48 hours and, if necessary to obtain this density, shall have an integral waterproofing admixture of a type approved by the Contracting Officer incorporated either in the cement used or in the concrete or water in process of mixing. Color shall be natural grey cement color and exposed surfaces shall have a rubbed dense finish free from cracks and defects, with sharp true arrises. Shop drawings shall be submitted for approval. Unless cured by high-pressure steam in a satisfactory manner, the trim items, following casting, shall be steam-treated or otherwise cured for a period of not less than 30 days prior to delivery to the building site and, upon delivery, shall be subject to wetting and inspection for crazing, any evidence of which will be cause for rejection.

a. Bases below windows and window sills shall be cast to profiles shown and shall be reinforced with 14 gage (American Standard Steel Wire) 2- by 2-inch woven wire mesh.

b. Wall filler blocks: Interior partition heights shall be adjusted to standard concrete block coursing by steel factory-made blocks or by site-precast, solid, unreinforced concrete blocks. No special blocks shall be less than 6 inches high, but they may be of any convenient lengths. Wall filler blocks shall be constructed of Class B concrete.

2-25 PRECAST ROOF SLABS shall be precast of Class AA concrete conforming to the requirements of this section, and to the designs shown. Provide reinforcing steel and bars for lifting all as detailed. Surfaces to receive plaster shall be treated for bonding as specified elsewhere in this section. Top surfaces shall have monolithic finish trowelled smooth. Slabs shall be cured same as specified elsewhere for other concrete. All slab units shall be marked to identify the unit for proper placement in accordance with the drawings. After curing, slabs shall be stored, stacked and transported in a manner to prevent the development of cracks or other defects. Concrete slabs shall be installed according to the detailed setting drawings and in a careful manner to prevent excessive bending and damage. Slabs shall be set true to line and level. Bearings shall be leveled with cement mortar if required.

2-26 CONCRETE CURBS AND GUTTERS shall be constructed of Class B concrete to the typical sections indicated on the drawings on compacted subgrade. Expansion joints of $\frac{1}{2}$ -inch thick, bituminous, premolded, non-extruding material shall be provided at approximately 25-foot intervals in the curbs and gutters, and between sidewalks and curbs and gutters. Where curbs and gutters abut inlets or catch basins, the expansion joint material shall be $\frac{3}{4}$ inch thick. Finish of curbs and gutters shall be as specified for wood-float finish when practicable.

2-27 SIDEWALKS shall be constructed of Class B concrete to the details on the drawings. Sidewalks shall be cross-sloped $\frac{1}{4}$ inch per foot toward drainage and grooved every five feet horizontally and longitudinally along the center line for 8- and 10-foot walks with an edging tool to the full depth of the tool or approximately $\frac{1}{4}$ inch deep. Edges, horizontal and longitudinal, shall be rounded with an edging tool. Sidewalks shall receive monolithic wood-float finish.